MONTANA
STATE
LIBRARY

This "cover" page added by the Internet Archive for formatting purposes

S
583.123
N11egaf
1993

MONTANA STATE LIBRARY
3 0864 0010 3950 5

U93LES@6MTUS

STATE DOCUMENTS COLLECTION
APR 22 1998
MONTANA STATE LIBRARY
1515 E. 6th AVE.
HELENA, MONTANA 59620

EFFECTS OF GRAZING ON ARABIS FECUNDA

1993 Progress Report

Peter Lesica
929 Locust
Missoula, MT 59802

and

Montana Natural Heritage Program
State Library
1515 E. 6th Avenue
Helena, MT 59620

Prepared for:

Bureau of Land Management
Butte District
P.O. Box 3388
Butte, MT 59702-3388

Agreement No. E950-A1-0006, No. 22

PLEASE RETURN

November 1993

INTRODUCTION

Arabis fecunda Rollins is a rosette-forming perennial in the Mustard Family (Brassicaceae). This recently described species (Rollins 1984) is endemic to highly calcareous, azonal soils in the foothills of the Sapphire Range in Ravalli County and in the Pioneer and Highland ranges of Beaverhead and Silver Bow counties, Montana (Lesica 1985, 1992, Schassberger 1988). Arabis fecunda generally occurs on steep, often eroding slopes with low vascular plant density. Arabis fecunda is a candidate for listing as a threatened or endangered species by the U.S. Fish and Wildlife Service (USDI-FWS 1990) and is considered threatened in Montana (Lesica and Shelly 1991).

Most sites at which Arabis fecunda occurs are grazed by livestock, but little is actually know about the effects of livestock grazing on this rare species. Recent studies have shown that A. fecunda is more common on soil occupied by cryptogamic soil crust (Lesica and Shelly 1992). These crusts are easily disturbed by livestock grazing; consequently, grazing may reduce A. fecunda populations at these sites (Lesica and Shelly 1992). Furthermore, A. fecunda often occurs on steep slopes with unstable soil. Trampling by livestock could reduce the number of A. fecunda plants on these slopes. On the other hand, A. fecunda seems to require open soil for seedling establishment (Lesica and Shelly, submitted) and may be facilitated by disturbance associated with grazing. The purpose of this study is to determine the effects of livestock grazing on populations of Arabis fecunda. on the north side of the Pioneer Range.

STUDY SITES

Locations of the study sites are shown in Figure 1.

Quartz Hill: From Dewey travel west on Hwy 43 ca. 0.3 miles and then turn south on gravel road (Beaverhead Forest Road #187). Proceed ca. 1 mile up the road. Exclosure is on a steep hillside west of the road (T1S R10W S8 NW1/4 of SE1/4). Aspect: 95°, Slope: 40° Elevation: 5,900 ft.

Thompson's Corner: From Dewey, travel west on Hwy 43 ca. 3.2 miles and then turn north on gravel road (Beaverhead National Forest Road #83). Continue ca. 0.2 miles and turn east on a small dirt road along the north side of the Big Hole River. Continue ca. 2 miles. Site is on the north side of the road on the west side of a small draw. T1S R10W S5 NW1/4 of NW1/4. Aspect: 100°, Slope: 20°, Elevation: 5,600 ft.

Dewey Cemetery: From Dewey travel west on Hwy 43 ca. 0.3 miles and then turn south on gravel road (Beaverhead Forest Road #187).

Figure 1. Location of Quartz Hill (Q), Thompson's Corner (T) and Dewey Cemetery (D) study sites.

Proceed ca. 0.5 mile up the road to just past the cemetery. Pull in on the small two-track going east just past the cemetery. Site is on the hill to the south. Aspect: ca. 220°, Slope: 30° Elevation: 5,800 ft.

METHODS

Field Methods

The Quartz Hill and Thompson's Corner exclosures were established and read on 11 June 1991. They were read again on 7 June 1993. The Dewey Cemetery exclosure was established and read on 7 June 1993.

There is one exclosure plot and one control plot at each site. Each exclosure plot is 6 ft X 6 ft, marked at the four corners by metal stakes and completely covered by firm wire mesh. Control plots are placed near by the exclosure and are identical except they are uncovered. Each plot is divided into four equal subplots (3 X 3 ft) to facilitate counting.

In each subplot estimate the basal cover of rock, moss-lichen, bare ground and vegetation, and estimate the canopy cover of grass, forbs and shrubs to the nearest 5%. In each subplot count the number of *Arabis fecunda* plants in each of three size classes:

Seedling (S): single rosette smaller that a penny
Rosette (R): single rosette larger than a penny or multiple rosettes
Fruiting (F): plants with flowers or fruits

Data Analysis

Changes in basal or vegetation cover between exclosure and control plots can be assessed by visual examination of the summary tables.

There are no replicates of the treatments at any of the sites; thus, statistical tests based on parametric distributions (e.g. t-test, analysis of variance) cannot be used. It is necessary to use counts (frequency) and contingency table analysis. The ratio of *Arabis fecunda* plants in year *t* to that in year *t+a* in the exclosure can be compared to the ratio from the control plot with a chi-square test. This test assumes that the observations are independent; i.e., the plants counted in year *t+a* cannot be the same as those counted in year *t*. Demographic monitoring studies from low-elevation sites indicate that 65% of cohorts have died after three years. Thus, the test cannot be considered valid unless comparing counts taken at least three years apart. Number of plants in each of the three size classes can also be compared using the same test.

RESULTS AND DISCUSSION

Exclosures at the Quartz Hill and Thompson's Corner sites were established in 1991; thus, a valid statistical analysis cannot be performed until 1994. Nonetheless, examination of the data is instructive. Grass cover increased more noticeably in the exclosure plots compared to the control plots. At Quartz Hill the number of A. fecunda plants decreased in the exclosure but increased outside of it between 1991 and 1993 (Table 1). The two ratios: 83/67 and 59/81 are significantly different (X^2=5.04, "p"=0.025). At Thompson's Corner there were more A. fecunda plants in both exclosure and control plots in 1993 compared to 1991, but the increase was much greater inside the exclosure (Table 2) The ratios 26/116 and 25/42 are significantly different (X^2=8.91,"p"=0.003). The statistical tests are invalid for reasons given above; however, it appears that the treatment had opposite effects at the two sites.

LITERATURE CITED

Lesica, P. 1985. Report on the conservation status of Arabis fecunda, a potential candidate species. Report to the U.S. Fish and Wildlife Service, Office of Endangered Species, Denver, CO.

Lesica, P. 1992. Vascular and sensitive plant species inventory for the Highland Mountains, Deerlodge National Forest. Montana Natural Heritage Program, Helena.

Lesica, P. and J. S. Shelly. 1991. Endangered, threatened and sensitive vascular plants of Montana. Montana Natural Heritage Program, Occasional Publication No. 1, Helena, Montana, USA.

Lesica, P. and J. S. Shelly. 1992. The effects of cryptogamic soil crust on the population dynamics of Arabis fecunda (Brassicaceae). American Midland Naturalist 128: 53-60.

Lesica, P. and J. S. Shelly. Submitted. Demographic analysis of competitive effects of Centaurea maculosa on Arabis fecunda. Journal of Ecology.

Rollins, R. C. 1984. Studies in the Cruciferae of western North America II. Contributions to the Gray Herbarium 214: 1-18.

Schassberger, L. A. 1988. An update of the report on the conservation status of Arabis fecunda, a candidate threatened species. Report to the U.S. Fish and Wildlife Service, Office of Endangered Species, Denver, CO.

USDI-Fish and Wildlife Service. 1990. Endangered and threatened wildlife and plants; review of plant taxa for listing as endangered or threatened species; notice of review. Federal Register 55 (35): 6184-6229.

Table 1. Basal and canopy cover of ground and vegetation in exclosure and control plots at three study sites. Litter cover is combined with bare ground.

Quartz Hill

	Exclosure		Control	
	1991	1993	1991	1993
Rock	0	13	0	10
Bare Ground	--	73	--	83
Moss/lichen	--	2	--	1
Basal Veg.	--	14	--	8
Grass	0	19	4	8
Forbs	3	25	4	14
Shrubs	2	8	3	1

Thompson's Corner

	Exclosure		Control	
	1991	1993	1991	1993
Rock	48	50	34	36
Bare Ground	--	31	--	53
Moss/lichen	--	4	--	3
Basal Veg.	--	15	--	9
Grass	9	45	8	11
Forbs	8	26	8	23
Shrubs	0	0	2	2

Dewey Cemetery

	Exclosure		Control	
	1991	1993	1991	1993
Rock	--	41	--	38
Bare Ground	--	54	--	58
Moss/lichen	--	1	--	1
Basal Veg.	--	5	--	5
Grass	--	10	--	5
Forbs	--	5	--	5
Shrubs	--	0	--	0

Table 2. Density of *Arabis fecunda* plants in three size classes in exclosure and control plots at study sites in 1991 and 1993. Size classes are seedling (S), rosette (R) and fruiting (F).

Quartz Hill

	Exclosure				Control			
	S	R	F	Total	S	R	F	Total
1991	--	59	24	83	--	55	4	59
1993	24	7	36	67	14	21	46	81

Thompson's Corner

	Exclosure				Control			
	S	R	F	Total	S	R	F	Total
1991	--	15	11	26	--	15	10	25
1993	15	29	72	116	2	15	25	42

Dewey Cemetery

	Exclosure				Control			
	S	R	F	Total	S	R	F	Total
1993	0	11	23	34	0	15	22	37

Arabis fecunda Grazing Exclosure Study

Site_____ Date_____

Examiner(s)_____

Estimate basal cover (rock, bare ground, moss/lichen, basal vegetation) and canopy cover (grass, forbs, shrubs) to the nearest 5% (T=1%) in each 1/4-plot. Count number of *A. fecunda* plants in each size class: seedling (S), rosette (R) and fruiting (F).

Exclosure

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
____	___	___	___	___	___	___	___	___	___	___	___
____	___	___	___	___	___	___	___	___	___	___	___
____	___	___	___	___	___	___	___	___	___	___	___
____	___	___	___	___	___	___	___	___	___	___	___
Total	___	___	___	___	___	___	___	___	___	___	___

Control

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
____	___	___	___	___	___	___	___	___	___	___	___
____	___	___	___	___	___	___	___	___	___	___	___
____	___	___	___	___	___	___	___	___	___	___	___
____	___	___	___	___	___	___	___	___	___	___	___
Total	___	___	___	___	___	___	___	___	___	___	___

Site Quartz Hill Date 11 June 91

Examiner(s) Roe, Shea

Exclosure

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	0	–	–	–	5	5	5	–	17	7	24
2	0	–	–	–	0	<5	0	–	4	6	10
3	0	–	–	–	0	<5	0	–	9	5	14
4	0	–	–	–	0	<5	<5	–	29	6	35

Control

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	0	–	–	–	5-10	<5	<5	–	13	2	15
2	0	–	–	–	<5	5-10	5-10	–	9	1	10
3	0	–	–	–	<5	<5	<5	–	6	0	6
4	0	–	–	–	<5	<5	<5	–	27	1	28

Site Dewey Cemetary Date 7 June 93

Examiner(s) Lesica, Shea

Exclosure

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	40	T	5	55	10	5	–	0	1	2	3
2	45	T	5	50	10	5	–	0	7	8	15
3	40	T	5	55	5	5	–	0	1	10	11
4	40	T	5	55	15	5	–	0	2	3	5

Control

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	35	T	5	60	5	5	–	0	5	4	9
2	30	T	5	65	5	5	–	0	3	3	5
3	40	T	5	55	5	5	–	0	2	12	14
4	45	T	5	50	5	5	–	0	5	3	8

Site Thompson Corner Date 11 June 91

Examiner(s) Roe, Shea

Exclosure

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	45	–	–	–	10-20	12	0	–	1	4	5
2	60	–	–	–	5-10	5-10	0	–	3	1	4
3	45	–	–	–	5-10	<5	0	–	5	4	9
4	40	–	–	–	5-10	5-10	0	–	6	2	8

Control

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	35	–	–	–	5-10	5-10	<5	–	5	1	6
2	35	–	–	–	5-10	5-10	<5	–	8	6	14
3	25	–	–	–	<5	5-15	<5	–	0	2	2
4	40	–	–	–	10-15	5-10	0	–	2	1	3

Site Thompson Corner Date 7 June 93

Examiner(s) Lesecw Shea

Exclosure

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	50	T	15	35	45	25	0	4	10	21	35
2	55	5	15	25	30	35	0	2	5	7	14
3	45	5	15	35	40	25	0	6	9	29	44
4	50	5	15	30	65	20	0	3	5	15	23

Control

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	50	T	10	40	10	20	5	0	5	5	10
2	35	T	10	55	15	20	T	0	4	9	13
3	20	5	10	65	5	30	T	2	2	7	11
4	40	5	5	50	15	20	0	0	4	4	8

Site Quartz Hill Date 7 June 93

Examiner(s) Lesica Shea

Exclosure

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	10	T	35	55	30	35	20	2	2	17	21
2	20	5	10	65	20	30	10	4	4	9	17
3	10	T	5	85	5	10	T	14	0	5	19
4	10	T	5	85	20	25	0	4	1	5	10

Control

Subplot	Rock	Moss	Basl Veg	Bare Grnd	Grss	Forb	Shrb	S	R	F	T
1	5	T	10	85	10	10	0	5	3	10	18
2	10	T	10	80	5	20	5	3	7	14	24
3	15	T	5	80	5	15	0	6	5	11	22
4	10	T	5	85	10	10	0	0	6	11	17

MONTANA
STATE
LIBRARY

This "cover" page added by the Internet Archive for formatting purposes